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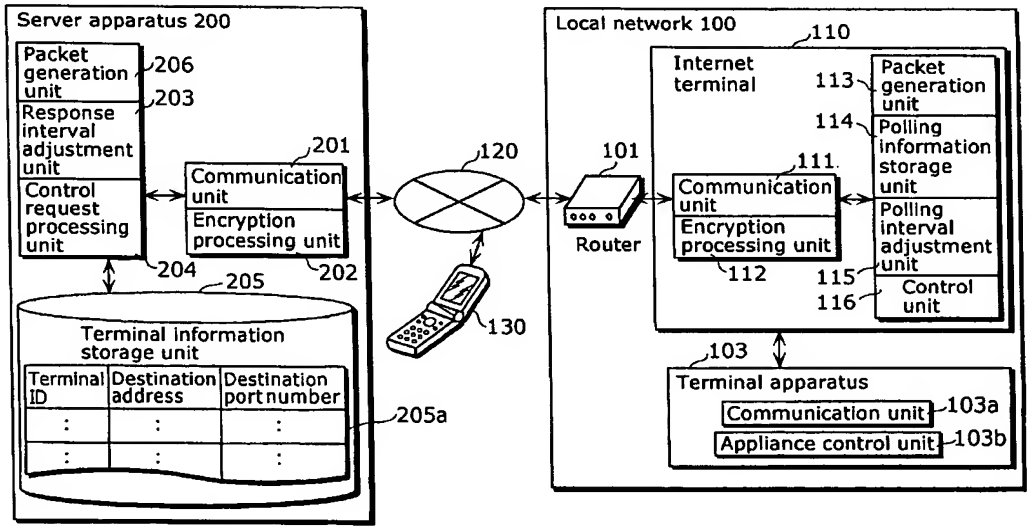
(54) Title: HOME TERMINAL APPARATUS AND COMMUNICATION SYSTEM



(57) Abstract: An internet terminal (110) according to the present invention is comprised of: a communication unit (111) that sends a local packet generated by a packet generation unit (113) and receives a response local packet from a server apparatus (200); an encryption processing unit (112) that encrypts the local packet to be sent out and decrypts the received response local packet; the packet generation unit (113) that generates the local packet; a polling information storage unit (114) that holds a terminal ID and a password used for identifying the internet terminal (110); a polling interval adjustment unit (115) that identifies a polling interval at which the local packet is periodically sent to the router (101); and a control unit (116) that sends control information to a terminal apparatus to be controlled and controls such terminal apparatus accordingly.

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DESCRIPTION

HOME TERMINAL APPARATUS AND COMMUNICATION SYSTEM

Technical Field

The present invention relates to a home terminal apparatus for sending and receiving packet data to and from a router connected to an external network, the home terminal apparatus being connected to the router via a home network, and a communication system using said home terminal apparatus.

Background Art

Recently, access networks such as ADSL (Asymmetric Digital Subscriber Line), optical fiber network and the like which are broadband capable of handling a large amount of communication data and which are accessible at all times have been widespread at an accelerated rate even among ordinary homes. At the same time, many kinds of home networks for organically connecting home appliances at home with one another are under standardization. Under these circumstances, it is expected that a user of these home appliances will be able to operate them from an outside location by remotely operating his/her mobile terminal which can be connected to the Internet and by transmitting control information to such home appliances via the Internet and a home network.

When a connection is made between external and home networks in a conventional method: (i) a plurality of home internet terminals assigned with local addresses are connected, via a home network, to a router connected to an internet network; (ii) the router is connected to the internet network via an internet service provider (ISP) using a communication line; and (iii) the internet service provider (ISP) assigns a global address to the router.

When an external server apparatus makes a control request to an internet terminal at home by the use of a global address, the

following conventional methods are used: a router is set to perform static IP masquerading (e.g. Japanese Laid-Open Patent Application No.2000-341337) and an internet terminal performs polling (e.g. Japanese Laid-Open Patent Application No.08-204704).

In static IP masquerading, a router, when receiving packet data in which a specific port number is described as a destination port number, converts the destination address into the local address of an internet terminal, and then routes the packet data to the internet terminal, with a global address and local addresses being registered in a conversion table as fixed addresses in advance. Therefore, it is possible in static IP masquerading to commence a session not only from the local side but also from the global side.

In the method in which an internet terminal performs polling, on the other hand, a router receives, from an internet terminal, a local packet to be sent to a server apparatus, and sends such packet to the server apparatus after converting the sender's address included in the packet into the global address of the router and converting the sender's port number included in the packet into a port number which can be used by the router. When this is done, a set of information including the local address of the internet terminal, the global address of the router, the sender's port number of the internet terminal, and the sender's port number of the router is to be stored in the conversion table for a specified period of time. Then, when receiving a response global packet that includes the details of a control intended for the internet terminal from the server apparatus, the router specifies the destination on the local network by converting the destination address and the destination port number included in the response global packet into the local address of the internet terminal and the destination port number of the internet terminal with reference to the conversion table, and routes the packet to the internet terminal.

Fig.13 is a sequence diagram showing the flow of packet data

to be sent for controlling a terminal apparatus at home in accordance with the conventional polling method.

The communication system is comprised of a server apparatus 1301 for sending a remote control request from a user in an outside location to a terminal apparatus at home, a router 1302 for making a conversion between global and local addresses and routing packet data between external and home networks, and an internet terminal 1303 for controlling a home appliance and the like according to the control request.

The internet terminal 1303 sends a local packet 1304 to the server apparatus 1301 in order to check whether there is any control request or not. When there is a control request from the user of a mobile terminal device, the server apparatus 1301 sends, to the internet terminal 1303, a response global packet 1306 as a response in which control information, the terminal ID of a terminal to be controlled, sender information, destination information such as the global address of the router 1302 are attached. Then, the internet terminal 1303 receives a response local packet 1307 that includes the control request, and a target terminal will be controlled accordingly. Note that a connectionless UDP (User Datagram Protocol) is used as a communication protocol.

In a communication using UDP, the router stores a relationship between local and global addresses for a certain period of time. Therefore, when the router 1302 receives the response global packet 1306 that includes the control information at an interval corresponding to the above period of time, it is possible to send the response local packet 1307 that includes the control request to the internet terminal 1303 by specifying the local address of a terminal to be controlled, with reference to a corresponding relationship table.

Disclosure of Invention

However, the use of the static IP masquerade method for the router requires an ordinary user to make a technical setting for the router such as assigning fixed port numbers used by the router to terminal apparatuses at home. Moreover, although trust and security is a prerequisite for a deal carried out between a service provider and a user when the remote control of home appliances is carried out, since a specific port number should be disclosed on an internet network, there are potential risks associated with security (e.g. home appliance is misoperated) due to a malicious third person who accesses and tampers remote control information, for example.

Meanwhile, when a local packet is sent from an internet terminal to a server apparatus using a simple polling method, the immediacy of an operation request to control a home appliance is lost because of the fact that there is a polling interval. To be more specific, as shown in Fig.13, since a corresponding relationship between local and global addresses stored in the router 1302 disappears after a certain period of time for reasons concerning security and the memory capacity of the router, the router 1302 cannot make a conversion between such local and global addresses and therefore cannot send the control request if the server apparatus 1301 sends a control request packet 1308 after the above corresponding relationship disappeared. This necessitates the router 1302 to wait for an acknowledgement request from the internet terminal 1303, causing a problem that it takes a certain period of time for a request to reach a home appliance from a mobile terminal device. A worst-case scenario is that the control information disappears in the middle of a polling interval. Also, the polling method has another problem that an internet terminal fails to receive a response global packet depending on the type of a router or an internet connection environment.

Furthermore, under the present circumstances, an internet service provider dynamically assigns a different global address to a

router when an always-on connection of ADSL and the like is temporarily broken. For this reason, even when a user tries to access the internet terminal for control information from its mobile terminal device from outside home, a communication cannot be established between them because the server apparatus cannot know a newly assigned global address of the router.

The present invention is intended to solve the above problems whose first object is to provide a home terminal apparatus that enables a control request which a user sends to a home terminal apparatus such as a home appliance and the like from an outside location, to be sent to a terminal apparatus to be controlled without requiring any waiting time, by the use of an existing router.

The second object is to provide a home terminal apparatus that enables the user to remotely control a home terminal apparatus from outside home using its mobile terminal device, soon after purchasing the home terminal apparatus, without needing to make complicated settings to such home terminal apparatus and a router.

The third object is to provide a home terminal apparatus that enables information including control information to be transmitted between a server apparatus, a router, and a home terminal apparatus even in the case where a new global address is dynamically assigned to the router.

The home terminal apparatus according to the present invention is a home terminal apparatus for sending/receiving packet data to and from a router that is connected to an external network to which a server apparatus is connected, the home terminal apparatus being connected to the router via a home network, comprising: a packet generation unit operable to generate packet data to be sent to the server apparatus; a judgment unit operable to judge a sending interval at which said packet data is sent; and a communication unit operable to send/receive the packet data to and from the server apparatus via the router, wherein the

communication unit sends the packet data periodically and repeatedly to the router according to the sending interval.

Also, in the home terminal apparatus according to the present invention, the router includes: an assignment unit operable to assign a unique local address to the home terminal apparatus; and a holding unit operable to hold a corresponding relationship between a global address assigned to the router and the local address of the home terminal apparatus for a predetermined period of time, and the home terminal apparatus further comprises a detection unit operable to detect said predetermined period of time during which the corresponding relationship is held in the router, wherein the judgment unit judges that the period detected by the detection unit or a period shorter than said period is the sending interval.

Accordingly, even in an environment where the router is connected to an internet network at all times, it is possible for a control request to control an internet terminal such as a home appliance and the like placed inside a house (on the local side) to be sent from a server apparatus (on the global side). This allows a real time remote controlling of the internet terminal by the user.

Moreover, the server apparatus connected to the home terminal apparatus according to the present invention further includes: a terminal information storage unit operable to store the following information included in the packet data received by the second communication unit as a set of terminal information: the terminal ID of the home terminal apparatus; a global address of the router which is a sender's address; and a global port number of the router which is a sender's port number; and an extraction unit operable to extract, from the terminal information storage unit, the global address and the global port number which correspond to the terminal ID, when a control request to control the home terminal apparatus with said terminal ID occurs, wherein the second packet generation unit generates control packet data that includes a control

command in accordance with the control request as well as the global address and the global port number extracted by the extraction unit as a destination address and a destination port number, respectively.

Accordingly, even when a different global address is dynamically assigned to the router due to a temporary disconnection of an always-on connection, it is possible for the server apparatus to obtain a newly assigned global address of the router.

Note that not only is it possible for the present invention to be embodied as a home terminal apparatus as described above, but also as a communication system composed of such home terminal apparatus, the router and the server apparatus, and as a communication method that includes, as its steps, the units of the home terminal apparatus. Furthermore, the present invention is also capable of being embodied as a program that causes a computer and the like to execute the above communication method. It should be also understood that such program can be distributed via recording media such as DVDs and CD-ROMs as well as via transmission media such as a communication network.

As described above, in an environment where a router is connected to an internet network at all times, the present invention allows a control request to control an internet terminal such as a home appliance and the like placed inside a house (on the local side) to be sent immediately from a server apparatus (on the global side) even when the polling method is used. Accordingly, it is possible for a user in an outside location to remotely operate the internet terminal inside the house in real time, using a mobile terminal device.

Moreover, since the polling method is used for the router, the user is not required to have any technical knowledge to set the router. Accordingly, by just getting connected to the router, the user who purchased a home terminal apparatus such as "Kurashi (a

Japanese word for "home life") Station" can remotely operate home appliances from an outside location using a mobile terminal device. This allows a dramatic improvement in the convenience of such user.

What is more, even when a different global address is dynamically assigned to the router due to a temporary disconnection of an always-on connection, since a global packet is periodically sent from the home terminal apparatus according to the present invention to the server apparatus, and such server apparatus then stores internet terminal information, it is possible for the server apparatus to obtain a newly assigned global address of the router and to send a control request from the mobile terminal device of the user.

For further information about the technical background to this application, Japanese Patent Application No.2002-261590 filed September 6, 2002, is incorporated herein by reference.

Brief Description of Drawings

These and other objects, advantages and features of the invention will become apparent from the following description thereof taken in conjunction with the accompanying drawings that illustrate a specific embodiment of the invention. In the Drawings:

Fig.1 is a schematic diagram showing an entire configuration of a communication system according to the first embodiment.

Fig.2 is a functional block diagram showing a server apparatus, an internet terminal, and a terminal apparatus and the like such as a home appliance connected to the internet terminal.

Fig.3 is a sequence diagram showing the internet terminal according to the first embodiment sending a local packet.

Fig.4 is a flowchart showing an operating procedure to be followed by the internet terminal according to the first embodiment when sending a local packet to the router periodically.

Fig.5 is a diagram showing an example data structure of a

local packet generated by the internet terminal according to the first embodiment.

Fig.6 is a reference diagram showing a corresponding relationship table held by the router according to the first embodiment.

Fig.7 is a flowchart showing a procedure followed by the server apparatus according to the first embodiment when receiving the global packet from the router and sending back a response global packet to the router.

Fig.8 is a diagram showing an example data structure of the response global packet generated by the server apparatus according to the first embodiment.

Fig.9 is a flowchart showing a procedure followed by the internet terminal according to the first embodiment when receiving the response global packet.

Fig.10 is a diagram showing a data structure of the local packet data which is sent by the internet terminal in order to obtain a holding period during which the router holds a corresponding relationship between a local address and a global address, when the internet terminal is activated.

Fig.11 is a flowchart showing a procedure followed by the internet terminal according to the first embodiment when obtaining the holing period during which the router holds a conversion table, so as to detect a polling interval at the time of activation.

Fig.12 is a functional block diagram showing a portal server, the server apparatus and the internet terminal according to the second embodiment.

Fig.13 is a sequence diagram showing a flow of packet data to be sent for controlling a terminal apparatus at home in accordance with the conventional polling method.

Best Mode for Carrying Out the Invention

An explanation is given of a communication system that incorporates an internet terminal that is a home terminal apparatus according to the present invention, with reference to the figures.

Note that the internet terminal at home according to the present invention utilizes the characteristics of a router when UDP, which is a connectionless protocol, is used as a communication protocol, and therefore there is no need to add a new functionality to a router itself. In a communication using a connectionless UDP protocol, a router holds a corresponding relationship between a local address and a global address only for a certain period of time at the time of sending/receiving packet data, since it is unknown whether there will be a response from the party on the other end of the communication or not. In a communication using TCP, on the other hand, a conversion table (to be also referred to as "corresponding relationship table") is generated when a connection is established between parties on the both ends of the communication, and a corresponding relationship between a local address and a global address is deleted when such connection is broken. Thus, the home internet terminal apparatus according to the present invention utilizes the characteristics of a router in the case of using UDP.

(First Embodiment)

Fig.1 is a schematic diagram showing an entire configuration of a communication system according to the first embodiment. The communication system according to the first embodiment is characterized by that control information from a mobile terminal device 130 in an outside location is transmitted in real time to an internet terminal at home.

Such communication system is composed of a server apparatus 200 dedicated to connecting a mobile terminal and a terminal apparatus on a home network, an internet network 120, a mobile terminal device 130 used by a user for sending and receiving remote control information to and from a terminal apparatus at

home, a router 101 for routing packet data in between external and local networks, and an internet terminal 110, each of which are connected to one another via a cable or wireless communication line. Note that the above networks are on an always-on state using ADSL, optical fiber and the like.

In a local network 100, the router 101 routes incoming and outgoing packet data to and from the house in an integrated manner, and the router 101 and a PC 102 and others inside home are connected to each other via LAN and the like. Also, the router 101 is connected to home appliances such as an air conditioner 103, a rice cooker 104, and a DVD video recorder 105 via radio waves from the internet terminal 110 such as "Kurashi Station", using a communication protocol such as ECHONET.

The router 101 is capable of routing packet data transmitted between the external and home networks, converting an IP address described in an IP header from a global address to a local address, and intentionally destroying packet data that matches a predetermined condition.

Connected to the external network are the mobile terminal device 130 such as a mobile phone by which the user can send control information from an outside location and the server apparatus 200 dedicated to receiving control information sent by the user and sending it to the internet terminal 110 at home, so as to remotely control a home appliance and the like.

Dotted lines shown in Fig.1 indicate the flow of remote control information. Control information sent by the user of the mobile terminal device 130 is sent to the dedicated server apparatus 200, which then specifies the global address of the router 101 on the home network, using a user ID, a telephone number, a password and the like. Next, the server apparatus 200 sends, to the terminal apparatus 103 and the like to be controlled, a global packet added with the global address, the terminal ID and others.

More importantly, since the local packet is periodically transmitted from the internet terminal 110 at home in the present invention, it is possible for the router 101 to always hold a table that shows a corresponding relationship between the global address of the router 101 and the local addresses of terminal apparatuses at home in the case where UDP is used as a communication protocol. This allows control information to be sent from the global side to the local side in real time in a communication which handles a UDP packet.

Note that the home appliance 103 and others on the local network 100 are wirelessly connected to the internet terminal 110, but the present invention is not limited to this, and therefore it is also possible that control information can be transmitted with the home appliance 103 and others being connected to the local network directly.

Fig.2 is an example functional block diagram showing the server apparatus 200, the internet terminal 110, and the terminal apparatus 103 and the like such as a home appliance connected to the internet terminal 110.

The server apparatus 200 is capable of receiving control information from the mobile terminal device 130, as well as constructing packet data resulted by adding destination address information to the control information and sending it to the target internet terminal 110 on the local network. Such server apparatus 200 is comprised of a communication unit 201, an encryption processing unit 202, a response interval adjustment unit 203, a control request processing unit 204, a terminal information storage unit 205, and a packet generation unit 206.

The communication unit 201 obtains, from the response interval adjustment unit 203, a response interval at which packet data is sent, and sends, to the target internet terminal 110, a response global packet generated by the packet generation unit 206

via the internet network 120, according to such response interval.

The encryption processing unit 202 decrypts the global packet sent by the router 101 and encrypts a response global packet to be sent to the router 101. DES, 3DES, AES or the like is used for this encryption and decryption processing.

The response interval adjustment unit 203 reads out the polling interval included in the global packet sent by the router 101 so as to determine an interval at which a response global packet should be sent, and passes the determined response interval to the communication unit 201.

The terminal information storage unit 205 holds a table 205a in which a set of information including the following information is stored as terminal information: the terminal ID; the sender's address; and the sender's port number included in the received global packet sent by the internet terminal 110.

The packet generation unit 206 generates a response global packet in response to the global packet. More specifically, the packet generation unit 206 specifies the destination address and the destination port number with reference to the table 205a stored by the terminal information storage unit 205 using the terminal ID of a terminal apparatus to be controlled sent by the mobile terminal device 130, and generates a response global packet by adding destination information and sender information to the header part and adding a control request command including the control information to the data part.

The router 101 is a routing device for routing packet data on the external and local networks, and the internet terminal 110 and others inside the house are connected to the external network via the router 101 in an integrated manner.

The router 101 is assigned with a unique global address by the internet service provider (ISP) 140, and a global packet sent by the router 101 is delivered to a router of such internet service

provider. The local packet is then sent to the server apparatus 200 as a destination over the network.

The mobile terminal device 130 is a device for sending and receiving control information used by the user in an outside location to remotely operate the home appliance 103 and others at home. Examples of control information are "start the rice cooker at six" and "record a TV program starting at seven". The mobile terminal device 130 is also capable of receiving information sent by the internet terminal 110 such as one indicating that a recorder is programmed, and one sent from a thermo sensor and a human sensor and the like.

The user of the mobile terminal device 130 specifies the terminal apparatus to be remotely operated and sends control request information by getting connected to the server apparatus 200 dedicated to the remote operation of terminal apparatuses at home.

The internet terminal 110 is a terminal apparatus capable of managing the home appliance 103 and others at home in an integrated manner, and is connected to the router 101 via LAN and the like. A communication protocol used on the home network is a secure protocol, an example of which is ECHONET. A unique local address is assigned to the internet terminal 110 by the router 101.

The internet terminal 110 is comprised of a communication unit 111, an encryption processing unit 112, a packet generation unit 113, a polling information storage unit 114, a polling interval adjustment unit 115, and a control unit 116.

The communication unit 111 sends a local packet generated by the packet generation unit 113 and receives a response local packet from server apparatus 200. In the present invention, the communication unit 111 is characterized by that it sends a local packet to the router 101 periodically according to a constant polling interval detected by the polling interval adjustment unit 115.

The encryption processing unit 112 encrypts a local packet to be sent out and decrypts a received response local packet. Note that the encryption processing unit 112 also uses DES and the like for encryption, as in the case of the encryption processing unit 202 of the server apparatus 200.

The packet generation unit 113 generates a local packet consisting of the header part added with address information and port numbers of both the sender and the destination, and of the data part added with data such as a response interval at which a response is made by the server apparatus 200.

The polling information storage unit 114 holds the terminal ID and the password for identifying the internet terminal 110.

The polling interval adjustment unit 115 detects a polling interval at which a local packet shall be periodically sent to the router 101, referring to a holding period during which the router 101 holds the corresponding relationship table, and sends the detected polling interval to the communication unit 111.

The control unit 116 receives, from the router 101, the local packet including a control command specified by the user using the mobile terminal device 130 from an outside location, and performs control processing by sending the control information to a target home appliance such as the rice cooker 104 and others according to the control command included in the local packet.

In Fig.2, home appliances connected to the internet terminal 110 include the air conditioner 103, the rice cooker 104, and the DVD-video recorder 105, which shall be connected to the internet terminal 110 in the first embodiment. However, these home appliances may also be connected directly to a wireless network, an electric wire, LAN and other networks.

The home appliance 103 and others has a communication unit 103a and an appliance control unit 103b. The communication unit 103a is a processing unit for sending and receiving control

information to and from the control unit 116 of the internet terminal 110. The appliance control unit 103b receives a control command from the internet terminal 110 and controls the home appliance 103. An example control command is "start the rice cooker at ten."

Next, an explanation is given of the procedure followed by the user when sending a control request from an outside location via the mobile terminal device 130. First, in the server apparatus 200, the communication unit 201 receives the control request, and the control request processing unit 204 generates a frame 2 by incorporating a command and data used for controlling the home appliance 103 into a control request command 809 in a data part 802, and passes it to the encryption processing unit 202. The encryption processing unit 202 encrypts the frame 2, the packet generation unit 206 generates a response global packet, and the communication unit 201 sends the generated global packet to the router 101.

Next, in the internet terminal 110, the communication unit 111 receives a response local packet, and the encryption processing unit 112 decrypts a data part 802 of the response local packet, and sends the resultant to the control unit 116. The control unit 116 obtains the control request command 809 included in the data part 802 of the response local packet, and sends a control command to the home appliance 103 via the home network, when such control request command 809 is intended for the home appliance 103.

The appliance control unit 103b of the home appliance 103 receives the control command, and controls the home appliance 103 according to the contents of the control command.

Fig.3 is a sequence diagram showing packet data being sent and received by the internet terminal 110 according to the first embodiment. Note that in the first embodiment, packet data is referred to differently as a local packet 301, a global packet 302, a response global packet 303 and a response local packet 304,

depending on which sending process such packet data is in.

The local packet 301, which is sent from the internet terminal 110 to the router 101, is made up of the header part which includes a destination address, a destination port number, a sender's address, and a sender's port number, and of the data part which includes data. Further, the sender's address includes the local IP address of the internet terminal 110, and the destination address includes the global IP address of the server apparatus 200.

The global packet 302 is sent from the router 101 to the server apparatus 200. The sender's address and the sender's port number included in the global packet 302 are converted by the router 101 into a global address unique to the router 101. The sender's address includes the global IP address of the router 101 and the destination address includes the global IP address of the server apparatus 200.

The response global packet 303 is sent from the server apparatus 200 to the router 101 according to a response interval. The global address and the port number of the router 101 are described as the destination address and the destination port number.

The response local packet 304 is generated by the router 101, which has received the response global packet, by converting the destination address from the global address and the port number of the router 101 into the local address and the port number of the internet terminal 110 with reference to the corresponding relationship table.

The internet terminal 110 is characterized by that it periodically sends a local packet to the router 101 at every polling interval when detecting an interval during which the router 101 holds the table that lists a relationship between local and global addresses.

Under UDP, the router 101 stores a communication status

between the global and local sides in the corresponding relationship table for a certain period of time. Usually, a corresponding relationship between the local address and the global address in a local packet sent to the router 101 disappears after a holding period. In the present invention, however, since the internet terminal 110 sends packet data at every polling interval which is shorter than the holding period, a corresponding relationship between the local and global addresses is always stored in the corresponding relationship table of the router 101. Note that the holding period during which the router 101 holds a corresponding relationship between the local address and the global address is a certain period of time starting from when the router 101 receives the local packet 301 or the response global packet 303 last time (e.g. 3 minutes).

Accordingly, it is possible for the router 101 to always convert, from a global address into a local address, the destination address and the destination port number which are included in the control request packet 305 that includes a control request from the server apparatus 200, as well as to route the resultant to the internet terminal 110 to be controlled.

Meanwhile, under the present circumstances, in a case where an always-on connection of ADSL, optical fiber and the like is temporarily broken by the user who has turned off the power of the router 101, for example, the internet service provider dynamically assigns a different global address to the router 101 again. Accordingly, there arises a problem that it is impossible to obtain such newly assigned global address of the router 101 even when the user tries to access the internet terminal 110 from the mobile terminal device 130 for control information.

In the present invention, however, since the internet terminal 110 periodically sends, to the server apparatus 200, packet data including the terminal ID, the sender's address, and the sender's port number and the like, it is possible for the terminal information

storage unit 205 of the server apparatus 200 which receives such packet data, to store the table 205a listing the latest terminal ID, destination address and destination port number and the like.

Therefore, it is possible for the server apparatus 200 to know the latest global address of the router 101 by checking the terminal ID of the internet terminal 110 to be controlled. This enables control information, which has been sent from the mobile terminal device of the user, to be sent to the internet terminal 110 to be controlled without requiring the user to carry out a special setting task, even when a different global address is assigned to the router 101 due to a temporary disconnection of an always-on connection.

Fig.4 is a flowchart showing the operating procedure to be followed by the internet terminal 110 according to the first embodiment when sending a local packet to the router 101 periodically. Fig.5 is a diagram showing an example data structure of a local packet 500 generated by the internet terminal 110 according to the first embodiment.

The polling information storage unit 114 holds terminal IDs and passwords, and the packet generation unit 113 generates a frame (to be referred to as "frame 1" hereinafter) incorporating a terminal ID and a password obtained from the polling information storage unit 114.

Fig.5 shows an example of the frame 1 included in the local packet 500. The frame 1, which is information included in the data part 502, includes the following data: a terminal ID 507 for identifying the internet terminal 110; a random value 508 which is a random number; a digest value 509 outputted by inputting the terminal ID 507, a local port number 510, the password, and the random value 508 into a specified function; the local port number 510 which the internet terminal 110 can use; and a polling interval 511 at which the internet terminal 110 sends a local packet periodically. As the above specified function, MD5 which is a hush

function can be used, for example.

Next, the encryption processing unit 112 obtains the local packet 500 from the packet generation unit 113 and encrypts the frame 1, and passes the resultant to the communication unit 111 (S401). DES and the like is an example encryption method here. The communication unit 111 adds, to the frame 1 which is the data part 502, a header part 501 that includes a destination address 503, a destination port number 504, a sender's address 505, and a sender's port number 506, and sends the local packet 500 containing the header part 501 and the data part 502 to the router 101.

In the local packet 500, the destination address 503 includes the address of the server apparatus 200, the destination port address 504 includes a port number which the server apparatus 200 can use, the sender's address 505 includes the address of the internet terminal 110, and the sender's port number 506 includes a port number which is equivalent to the local port number 510, and the data part 502 includes the encrypted frame 1.

The communication unit 111 obtains the polling interval from the polling interval adjustment unit 115, and judges whether the local packet 500 is actually sent at such polling interval or not (S402). When the result of the judgment shows that it is such polling interval (Y in S402), the communication unit 111 sends the local packet 500 to the router 101 (S403), whereas it obtains a polling interval when the result of the judgment shows that it is shorter than such polling interval (N in S402). Note that the internet terminal 110 performs processing for receiving the response global packet after sending the local packet 500. A detailed explanation of this receiving process is given later.

Fig.6 is a reference diagram showing a corresponding relationship table 600 held by the router 101 according to the first embodiment. The corresponding relationship table 600 lists, in a

paired manner, local addresses and port numbers of the local network side and the global address and port numbers of the external network side.

An explanation is given of conversion processing performed by the router 101 when receiving the local packet 500 from the internet terminal 110 and converting it into a global packet so as to send the resultant to the server apparatus 200. When receiving the local packet 500, the router 101 generates a global packet by converting the sender's address 505 included in the local packet 500 into the global address of the router 101 and by converting the sender's port number 506 included in the local packet 500 into a port number which can be received by the router 101 with the aim of making an efficient use of the global address, and sends the generated global packet to the server apparatus 200.

Moreover, the router 101 stores, in the corresponding relationship table 600, a combination of the local address and the sender's port number of the internet terminal 110 and the global address and the port number of the router 101 as table information.

Fig.7 is a flowchart showing the procedure followed by the server apparatus 200 according to the first embodiment when receiving the global packet from the router 101 and sending back a response global packet to the router 101.

First, the communication unit 201 of the server apparatus 200 receives the global packet from the router 101, and passes it to the encryption processing unit 202.

Next, the encryption processing unit 202 decrypts the data part 502 included in the global packet, and sends the resultant to the terminal information storage unit 205 (S701). Then, the terminal information storage unit 205 performs authentication on the received global packet. In this authentication processing, the terminal information storage unit 205: (i) obtains the terminal ID 507, the random value 508, the digest value 509, and the local port

number 510 included in the data part 502, (ii) searches for a password corresponding to the terminal ID 507, (iii) determines a value by inputting, into a function equivalent to the one used by the packet generation unit 113, the terminal ID 507, the local port number 510, the password, and the random value 508, and (iv) compares the determined value with the digest value 509 (S702).

When the authentication failed (N in S702), the terminal information storage unit 205 destroys the received global packet, whereas when the authentication succeeded (Y in S702), the terminal information storage unit 205 obtains a set information including the terminal ID 507, the sender's address 505, and the sender's port address 506 included in the global packet, and generates and stores the table 205a, with the above obtained set of information as terminal information (S703).

Furthermore, the terminal information storage unit 205 obtains a polling interval 511 included in the global packet, and passes it to the response interval adjustment unit 203. From such polling interval 511, the response interval adjustment unit 203 determines a response send interval which is an interval at which a response global packet, which is a response to the global packet, should be sent back (S704).

Subsequently, the control request processing unit 204 detects whether or not a control request to control the internet terminal 110 has been received from the mobile terminal device 130 during the above determined response send interval after the global packet was received (S705).

When judging that there is a control request (Y in S705), the control request processing unit 204 stores the contents of the control request in a control request command to be incorporated into the response global packet (S706). Meanwhile, when no control request occurs during the response send interval (N in S705), the control request processing unit 204 stores, in the control

request command, data indicating that there is no control request (S707), generates a frame (to be referred to as "frame 2" hereinafter) to be incorporated into the response global packet, and passes it to the encryption processing unit 202. Note that, since it is not necessary for the server apparatus 200 to send, to the internet terminal 110, information indicating that there is no control request when the user of the mobile terminal device 130 makes no control request to control a home appliance, S707 may be skipped and a response global packet may be sent back only when a control request is sent from the mobile terminal device 130.

Subsequently, the control request processing unit 204 prepares the frame 2 which includes the control request command, the terminal ID and the port number unique to the internet terminal 110 to be controlled (S708), and the packet generation unit 206 generates a response global packet consisting of the header part that includes the destination and sender's addresses and port numbers, and of the data part that includes the frame 2. Note that Fig.8 illustrates the data structure of such response global packet. Also note that information such as "turn the operating state of the air conditioner 103 to ON" is described in the control command.

The encryption processing unit 202 obtains the response global packet generated by the packet generation unit 206 and encrypts its data part, and the communication unit 201 sends the encrypted response global packet to the router 101 and terminates a series of processing (S709).

Fig.8 is a diagram showing an example data structure of a response global packet 800 generated by the server apparatus 200 according to the first embodiment.

The frame 2, which is prepared by the control request processing unit 204, is contained in a data part 802, and includes: a terminal ID 807 of the internet terminal 110 to be controlled; a port number 808 which includes the local port number 510 included in

the data part 502 of the global packet; and a control request command 809 that includes a control command requested from the mobile terminal device 130 to the internet terminal 110.

The frame 2 is passed to the packet generation unit 206 after being encrypted by the encryption processing unit 202, and then the response global packet 800 including the header part 801 and the data part 802 is generated.

The packet generation unit 206 passes such generated response global packet 800 to the communication unit 201, which then extracts, from the table 205a in the terminal information storage unit 205, the terminal ID of the internet terminal 110 to be controlled, i.e. the terminal ID which matches the terminal ID 807 included in the frame 2, and obtains the terminal ID 807, a destination address 803, and a destination port number 804. Then, the communication unit 201 adds such obtained information to the header of the response global packet so as to generate such response global packet.

In the response global packet 800, the destination address 803 includes a terminal address which is the global address of the router 101, the destination port number 804 includes a terminal port number, a sender's address 805 includes the address of the server apparatus 200, and a sender's port number 806 includes a port number which the server apparatus 200 can use.

Next, an explanation is given of the procedure followed by the router 101 when receiving the response global packet form the server apparatus 200, converting it into a response local packet, and sending such response local packet to the internet terminal 110.

First, on the receipt of the response global packet from the server apparatus 200, the router 101 converts the destination address 803 included in the response global packet into the address of the internet terminal 110, and converts the destination port number 804 included in the response global packet into the port

number of the internet terminal 110 with reference to the conversion table, and generates a response local packet. Then, the router 101 sends such generated response local packet to the internet terminal 110.

Note that the router 101 deletes a pair of the address and the port number of the internet terminal 110 and the address and the port number of the router 101 stored in the conversion table, when there was no local packet or response global packet received during a certain period of time. Meanwhile, when the above pair does not already exist in the conversion table of the router 101, the response global packet shall be destroyed.

Fig.9 is a flowchart showing the procedure followed by the internet terminal 110 according to the first embodiment when receiving the response local packet.

The communication unit 111 waits for receiving a response local packet during the polling interval, after sending the local packet to the router 101 (S901).

When receiving the response local packet during the polling interval (Y in S902), the communication unit 111 passes such response local packet to the encryption processing unit 112. The encryption processing unit 112 decrypts the data part 802 of the response local packet, and passes the resultant to the control unit 116. The control unit 116 then performs authentication by making a judgment on whether the terminal ID 807 included in the data part 802 matches the terminal ID possessed by the internet terminal 110 and on whether the port number 808 matches the local port number 510 used when the frame 1 was generated (S903). When the authentication failed (N in S903), the communication unit 111 returns to the wait state for receiving the response local packet.

When the authentication succeeded (Y in S903), the control unit 116 obtains and reads out the control request command 809 included in the data part 802. And, when the contents of the

control request command 809 indicates "no control request" (N in S904), the control unit 116 terminates the receiving process.

On the other hand, when the contents of the control request command 809 indicates "there is a control request" and it is intended for controlling the internet terminal 110 or the home appliance 103 and the like on connection (Y in S904), the control unit 116 controls the internet terminal 110 or the connected home appliance 103 and the like according to the contents of the control request command 809 (S905). An example of this control request is "start the air conditioner at seven."

Meanwhile, when the communication unit 111 did not receive the response local packet during the polling interval (N in S902), the polling interval adjustment unit 115 performs processing for shortening such polling interval (S906). For example, when the polling interval is set to 20 minutes as the default, such polling interval is made shorter minute by minute (e.g. 19 minutes, 18 minutes...) until the response local packet is received. Assuming that the communication unit 111 receives the response local packet when the polling interval has been shortened to 10 minutes, the local packet is sent to the router 101 every 10 minutes from then on. Note that the polling interval may be shortened to 10 minutes or shorter, e.g. 9.5 minutes, in such a case

Also note that, in the internet terminal 110 according to the first embodiment, the polling interval adjustment unit 115 may check the table holding period of the router 101 which is connected at the time of activation, instead of shortening the polling interval as described above.

Fig.10 is a diagram showing the data structure of the local packet data which is sent by the internet terminal 110 in order to obtain the holding period during which the router 101 holds a corresponding relationship between a local address and the global address, when the internet terminal 110 is activated.

For example, the packet generation unit 113 of the internet terminal 110 generates four local packets, each having a different destination port number (e.g. 5000~5003) as its destination port number included in a header part, a different sender's port number, and a different polling interval (e.g. 1 minutes ~ 4 minutes with a 1-minute time interval between each interval) as its response interval included in a data part. Then, the communication unit 111 sends such four local packets all at once to the server apparatus 200. Note that these time intervals and port numbers are just examples and therefore that the present invention is not limited to them.

Since the corresponding relationship between global and local addresses is usually cached for a certain period of time in the corresponding relationship table 600 possessed by the router 101, the corresponding relationship is stored for such certain period of time, but it is to be deleted after the certain period of time. Thus, response packet data beyond the holding period shall not be sent back.

Accordingly, the communication unit 111 of the internet terminal 110 performs the receiving process, but in a case where it has received response global packets corresponding to local packets 1001, 1002, and 1003, but it has not received a response global packet corresponding to a local packet 1004, the polling interval adjustment unit 115 judges that a corresponding relationship is cached for "3 minutes" in the router 101, and sets a polling interval of local packets to 3 minutes.

Fig.11 is a flowchart showing the procedure followed by the internet terminal 110 according to the first embodiment when obtaining the holing period during which the router 101 holds the conversion table, so as to detect a polling interval at the time of activation.

First, the packet generation unit 113 of the internet terminal 110 generates a plurality of local packets whose polling interval is

different from each other's, the encryption processing unit 112 encrypts such generated local packets, and the communication unit 111 sends them to the router 101 (S1101).

Next, the communication unit 111 of the internet terminal 110 waits for response local packets (S1102), and judges whether response local packets have been received or not (S1103). When the response local packets have been received (Y in S1103), the polling interval adjustment unit 115 obtains, as a corresponding relationship holding period of the router 101, the last and longest polling interval which has been received (S1104).

Meanwhile, when the response local packets have not been received (N in S1103), the internet terminal 110 terminates this processing.

As described above, the internet terminal 110 according to the first embodiment is comprised of the polling interval adjustment unit 115 that detects the holding period during which the router 101 holds the conversion table and judges a polling interval at which local packets are sent out, and of the communication unit 111 that sends a local packet periodically and repeatedly to the router 101 according to such polling interval.

Accordingly, in an environment where the router 101 is connected to an internet network at all times, since the router 101 can always possess a corresponding relationship table that lists a relationship between global and local addresses and port numbers even in the polling method, the server apparatus 200 generates a global packet which includes the global address of the router 101 corresponding to its terminal ID and sends it to the router 101, and consequently the router 101 can convert the global address into a local address on the local network with reference to the conversion table which it stores, even when the user in an outside location sends a control request via the mobile terminal device 130. Accordingly, it is possible to remotely control the home appliance

103 and the like at home in a manner which satisfies the user's requirement by sending, in real time, control information sent by the user in an outside location using the mobile terminal device 130 to the target internet terminal 110 at home.

What is more, according to the present invention, since there is no need for making a setting for the router by using the polling for the router, it is possible for a user to remotely operate a home appliance from an outside location by connecting the internet terminal 110 according to the present invention to the existing router 101. Thus, the present invention is capable of making a dramatic improvement in the convenience of its user.

Regarding the server apparatus 200, since it needs to send a response global packet to a terminal apparatus at home to be controlled only when a user makes a control request from outside home using the mobile terminal device 130, it is not necessary for the internet terminal 110 to inquire the server apparatus 200 about the presence/absence of a control request, as is required in a conventional method.

Moreover, since the polling interval adjustment unit 115 of the internet terminal 110 detects, at the time of activation, the holding period during which the router 101 holds the conversion table, it is possible to avoid a situation in which a user cannot make a control request from an outside location because of the reason that the corresponding relationship stored by the router 101 disappeared, as seen in a conventional case.

Furthermore, since even an existing router can hold a relationship between destination and sender's addresses in a UDP packet for a certain period of time, there is no need for adding a new functionality to a router, meaning that the present invention can be embodied utilizing an existing router.

Also, it is possible for the server apparatus 200 to know the latest global address of the router 101 by checking the terminal ID

of the internet terminal 110 to be controlled. Accordingly, even in a case where a different global address is assigned to the router 101 due to a temporary disconnection of an always-on connection, the user can send control information from the mobile terminal device 130 to the internet terminal 110 to be controlled without needing to carry out a special setting task.

Note that it is also conceivable that the result of controlling the internet terminal 110 and the home appliance 103 according to the first embodiment is sent to the user's mobile terminal device 130. Examples of such control result are "timer setting of the air conditioner from seven completed" and "hot-water supply completes at ten". The procedure of sending a control result is explained below.

The control unit 116 of the internet terminal 110 obtains the control request command 809 included in the data part 802 of the response local packet, and controls the internet terminal 110 accordingly. When a terminal to be controlled is the air conditioner 103, for example, the contents of the control request command 809 is sent to the appliance control unit 103b of the air conditioner 103.

The appliance control unit 103b of the home appliance 103 controls the home appliance 103 according to the control request, and sends data indicating the result of such control to the control unit 116 of the internet terminal 110.

The control unit 116 of the internet terminal 110 passes, to the encryption processing unit 112, a frame (to be referred to as "frame 3" hereinafter) to be sent to the server apparatus 200 by incorporating, into the frame 3, the data sent by the home appliance 103 indicating its control result or the control result of the internet terminal 110.

The encryption processing unit 112 encrypts the frame 3, and passes the resultant to the communication unit 111. The communication unit 111 generates a local packet to be sent to the

server apparatus 200 in a manner equivalent to the one explained above, and sends it to the router 101. Thus, such local packet includes data indicating the control result.

The router 101 converts the local address described in the received local packet into a global address, stores them in the corresponding relationship table 600, and sends the global packet to the server apparatus 200 via the internet network 120.

In the server apparatus 200, the communication unit 201 receives the global packet sent by the router 101 and passes it to the encryption processing unit 202, which then decrypts the frame 3 in the received global packet and passes the resultant to the control request processing unit 204. Then, the control request processing unit 204 reads in the data indicating the control result of the home appliance 103 or the data indicating the control result of the internet terminal 110, so as to obtain the control result, and the communication unit 201 sends such control result to the mobile terminal device 130 and a series of processing is terminated.

Note that the polling interval adjustment unit 115 shortens a polling interval at which a local packet is sent by the minute in the explanation of the present invention, but a polling interval does not necessarily have to be shortened by the minute, and therefore that it may vary depending on the implementation of the internet terminal 110.

(Second Embodiment)

Referring to Fig.12, an explanation is given of a second embodiment of the communication system according to the present invention.

Fig.12 is a functional block diagram showing a portal server 1201, the server apparatus 200 and the internet terminal 110 according to the second embodiment. In the communication system according to the second embodiment, the portal server 1201 is newly added to the configuration of the communication system

according to the above-described first embodiment illustrated in Fig.2. The second embodiment is characterized by that a control request from the user's mobile terminal device 130 is sent to this portal server 1201, and the home appliance 103 and the like connected to the internet terminal 110 is controlled by the portal server 1201 via the server apparatus 200. Note that, in Fig.12, the same constituent elements as those illustrated in Fig.2 are assigned with the same numbers, and detailed explanations thereof are omitted.

This portal server 1201 is a server which handles, for example, an application dedicated to remotely operating a home appliance at home from an outside location, and is comprised of a communication unit 1204 for sending and receiving packet data to and from the outside, an encryption processing unit 1203 for encrypting and decrypting packet data, and a request processing unit 1202. The request processing unit 1202 reads in a control request sent from a mobile terminal device.

Next, an explanation is given of the processing procedure of the communication system according to the second embodiment. First, the user sends, to the portal server 1201, a control request for controlling the internet terminal 110 such as a home appliance having a terminal ID unique to the home network, via the internet network 120 by the use of the mobile terminal device 130. An example of the control request is "program the DVD-video recorder to record the news program at ten", as described above.

Then, the communication unit 1204 of the portal server 1201 receives the control request from the mobile terminal device 130, and sends such control request to the server apparatus 200 via the internet network 120.

Subsequently, the control request processing unit 204 of the server apparatus 200 generates the control request command 809 to be incorporated into the frame 2 according to the received control

request, and further incorporates the address of the portal server 1201 into such control request command 809.

The subsequent processing is equivalent to that in the first embodiment: the control request processing unit 204 generates the frame 2 including the control request command 809 and the address of the portal server 1201, and passes it to the packet generation unit 206, and the packet generation unit 206 generates a response global packet that includes the header part, and passes it to the encryption processing unit 202. The encryption processing unit 202 encrypts the frame 2, which is then sent to the router 101 by the communication unit 201.

Then, the communication unit 111 of the internet terminal 110 receives the response local packet from the router 101, and the encryption processing unit 112 decrypts the data part 802 of such response local packet and passes the resultant to the control unit 116. The control unit 116 obtains the control request command 809 included in the data part 802 of the response local packet, and controls the internet terminal 110 or the home appliance 103 according to the contents of the control request command 809. Subsequently, the appliance control unit 103b of the home appliance 103 sends data indicating its control result to the internet terminal 110.

Next, the control unit 116 of the internet terminal 110 passes, to the packet generation unit 113, the data indicating the control result sent by the home appliance 103 or the data indicating the control result of the internet terminal 110, and then the packet generation unit 113 generates a response local packet consisting of the data part and the header part, and sends it to the encryption processing unit 112.

The encryption processing unit 112 encrypts the data part of such response local packet, and the communication unit 111 sends, to the router 101, a local packet to be sent to the portal server 1201.

The router 101 converts such received local packet into a global packet to be sent to the portal server 1201, and sends the global packet to the portal server 1201 via the internet network 120.

The communication unit 1204 of the portal server 1201 receives the global packet including the control result information routed by the router 101 and passes it to the encryption processing unit 1203, which then decrypts the data part in such global packet and passes it to the request processing unit 1202. Subsequently, the request processing unit 1202 obtains the data indicating the control result of either the home appliance 103 or the internet terminal 110 included in the data part and passes it to the communication unit 1204, and the communication unit 1204 sends the received control result of either the home appliance 103 or the internet terminal 110 to the mobile terminal device 130.

As explained above, since the communication system according to the second embodiment incorporates the portal server 1201, which uses a dedicated application for the internet terminal 110 for remotely operating home appliances, it is possible to employ the portal server 1201 as a dedicated server of the internet terminal 110.

Moreover, even in a case where an internet terminal for providing a different kind of services is to be provided, it is possible to use the same server apparatus 200 by appropriately using either the portal server 1201 or the server apparatus 200 that periodically receives a packet, depending on need.

Note that a mobile phone is used as the mobile terminal device 130 in explaining the preferred embodiments, but the present invention is not limited to this, and therefore that an equivalent functionality can be achieved by using another terminal device/apparatus including a PC and a PDA which can be connected to the internet network 120.

Industrial Applicability

The home terminal apparatus according to the present invention is suited to be used as a terminal apparatus for sending and receiving packet data to and from a router connected to an external network, by being connected to such router via a home network, and more particularly, the home terminal apparatus according to the present invention is applicable to a terminal apparatus for remotely operating home appliances in an integrated manner as well as applicable to home appliances and the like such as an air conditioner.

CLAIMS

1. A home terminal apparatus for sending/receiving packet data to and from a router that is connected to an external network to which a server apparatus is connected, the home terminal apparatus being connected to the router via a home network, comprising:

a packet generation unit operable to generate packet data to be sent to the server apparatus;

a judgment unit operable to judge a sending interval at which said packet data is sent; and

a communication unit operable to send/receive the packet data to and from the server apparatus via the router,

wherein the communication unit sends the packet data periodically and repeatedly to the router according to the sending interval.

2. The home terminal apparatus according to Claim 1,

wherein the router includes:

an assignment unit operable to assign a unique local address to the home terminal apparatus; and

a holding unit operable to hold a corresponding relationship between a global address assigned to the router and the local address of the home terminal apparatus for a predetermined period of time, and

the home terminal apparatus further comprises a detection unit operable to detect said predetermined period of time during which the corresponding relationship is held in the router,

wherein the judgment unit judges that the period detected by the detection unit or a period shorter than said period is the sending interval.

3. The home terminal apparatus according to Claim 1,

wherein the packet generation unit generates the packet data

to be sent to the server apparatus that includes at least the following information in a header part: (i) the local address of the home terminal apparatus as a sender's address; (ii) a local port number of the home terminal apparatus as a sender's port number; (iii) an address of the server apparatus as a destination address; and (iv) a port number of the server apparatus as a destination port number, and that includes at least the following information in a data part: (i) a unique terminal ID of the home terminal apparatus; and (ii) a response interval at which response packet data is sent as a response from the server apparatus.

4. The home terminal apparatus according to Claim 3,

wherein the judgment unit judges that the sending interval should be shortened, when the communication unit has not received the response packet data from the router within the sending interval.

5. The home terminal apparatus according to Claim 3,

wherein the packet generation unit generates a plurality of packet data in which the destination port number, the sender's port number and the response interval are different from packet data to packet data,

the communication unit sends, all at once, said plurality of packet data generated by the packet generation unit, and

the detection unit detects the predetermined period of time during which the corresponding relationship is held in the router, from the response interval at which the response packet data is sent.

6. The home terminal apparatus according to Claim 5,

wherein the detection unit detects a longest response interval as the predetermined period of time in the router, out of a plurality

of response packet data sent by the server apparatus in response to the plurality of packet data sent by the home terminal apparatus.

7. The home terminal apparatus according to Claim 3,

wherein the server apparatus includes:

a second communication unit operable to send/receive the packet data;

a response interval adjustment unit operable to obtain the response interval included in the packet data at which the response packet data is sent to the home terminal apparatus, and determine a response period during which the response packet data should be sent; and

a second packet generation unit operable to generate the response packet data to be sent to the home terminal apparatus,

wherein the second communication unit sends, to the router, the response packet data generated by the second packet generation unit according to said response period.

8. The home terminal apparatus according to Claim 7,

wherein a mobile terminal device for sending a control request to control the specific home terminal apparatus is further connected to the external network, and

the second packet generation unit in the server apparatus generates control packet data including the control request which is sent by the mobile terminal device and received by the second communication unit.

9. The home terminal apparatus according to Claim 8, further comprising a control unit operable to control said home terminal apparatus according to the control request.

10. The home terminal apparatus according to Claim 9,

wherein a plurality of terminal apparatuses are connected to the home terminal apparatus via the home network,

each of the terminal apparatuses includes an apparatus control unit operable to control said each of the terminal apparatuses itself,

the communication unit sends the control request included in the control packet data to each of the terminal apparatuses, and

the apparatus control unit controls said each of the terminal apparatuses according to the received control request.

11. The home terminal apparatus according to Claim 10,

wherein the control unit receives a control result from the apparatus control unit,

the communication unit sends packet data including said control result to the server apparatus, and

the second communication unit in the server apparatus sends the control result included in the packet data to the mobile terminal device.

12. The home terminal apparatus according to Claim 11,

wherein a portal server is connected to the external network,

the portal server sends, to the server apparatus, a portal server connection request to be sent to the home terminal apparatus with the specific terminal ID,

the second packet generation unit in the server apparatus generates the response packet data that includes an address of the portal server according to said portal server connection request,

the communication unit in the home terminal apparatus receives the response packet data from the router, and

the packet generation unit generates control result packet data that includes at least the control result and the address of the portal server included in the response packet data as a destination

address.

13. The home terminal apparatus according to Claim 12,

wherein the mobile terminal device sends, to the portal server, the control request to be sent to the home terminal apparatus with the specific terminal ID, and

the portal server sends the portal server connection request to the server apparatus, when receiving the control request.

14. The home terminal apparatus according to Claim 12,

wherein the portal server sends, to the mobile terminal device, the control result included in the control result packet data, when receiving the control result packet data from the router.

15. The home terminal apparatus according to Claim 7,

wherein the server apparatus further includes:

a terminal information storage unit operable to store the following information included in the packet data received by the second communication unit as a set of terminal information: the terminal ID of the home terminal apparatus; a global address of the router which is a sender's address; and a global port number of the router which is a sender's port number; and

an extraction unit operable to extract, from the terminal information storage unit, the global address and the global port number which correspond to the terminal ID, when a control request to control the home terminal apparatus with said terminal ID occurs,

wherein the second packet generation unit generates control packet data that includes a control command in accordance with the control request as well as the global address and the global port number extracted by the extraction unit as a destination address and a destination port number, respectively.

16. The home terminal apparatus according to Claim 15,

wherein the second communication unit sends the control packet data to the home terminal apparatus via the router, only when the control request occurs.

17. The home terminal apparatus according to Claim 15,

wherein the second communication unit sends, to the router, the control packet data which does not include the control command, when there is no control request from the mobile terminal device during the response period.

18. The home terminal apparatus according to Claim 3, further comprising a storage unit operable to store a password used for performing authentication on the terminal ID,

wherein the packet generation unit obtains a digest value by inputting, into a predetermined function, the terminal ID and the password which are obtained from the storage unit and a random number, and generates packet data by incorporating the terminal ID, the random number, and the digest value into the data part, and

the communication unit sends the generated packet data to the router, and

the server apparatus further includes:

a second storage unit operable to store an authentication terminal ID and an authentication password, the authentication terminal ID containing information which is the same as information of the terminal ID included in the packet data and the authentication password containing information which is the same as information of the password; and

a second authentication unit operable to obtain an authentication digest value by inputting, into the predetermined function, the authentication terminal ID, the authentication password, and the random number included in the packet data, and

perform authentication on the received packet data by comparing the authentication digest value with the digest value included in the packet data.

19. The home terminal apparatus according to Claim 18,

wherein the packet generation unit obtains the digest value by inputting, into the predetermined function, the terminal ID, the password, the local port number and the random number, and generates packet data that includes the terminal ID, the random number, the digest value, and the local port number, and

the second authentication unit in the server apparatus receives said packet data, obtains an authentication digest value by inputting, into the predetermined function, the authentication terminal ID and the authentication password, and the local port number and the random number included in the packet data, and performs authentication on the received packet data by comparing said authentication digest value with the digest value included in the packet data.

20. The home terminal apparatus according to Claim 19,

wherein the packet generation unit makes the local port number a random number.

21. The home terminal apparatus according to Claim 18,

wherein the second packet generation unit in the server apparatus generates the response packet data that includes the terminal ID and the local port number included in the packet data which are extracted by the extraction unit, and

the home terminal apparatus further comprises an authentication unit operable to obtain the terminal ID and the local port number included in the response packet data, and perform authentication on the response packet data by comparing said

obtained terminal ID and the local port number with the terminal ID and the local port number included in the packet data.

22. The home terminal apparatus according to Claim 1, further comprising an encryption processing unit operable to encrypt and decrypt the packet data.

23. A communication system comprising:

a server apparatus connected to an external network;

a home terminal apparatus connected to a home network; and

a router which connects the external network and the home network,

wherein the home terminal apparatus includes:

a packet generation unit operable to generate packet data to be sent to the server apparatus;

a judgment unit operable to judge a sending interval at which said packet data is sent; and

a communication unit operable to send/receive the packet data to and from the server apparatus via the router,

the router includes:

an assignment unit operable to assign a unique local address to the home terminal apparatus;

a holding unit operable to hold a corresponding relationship between a global address assigned to the router and the local address of the home terminal apparatus for a predetermined period of time; and

a conversion unit operable to make a conversion between the local address and the global address included in the packet data sent by the home terminal apparatus or the server apparatus, with reference to the corresponding relationship, and

the server apparatus includes:

a second communication unit operable to receive the packet

data sent by the home terminal apparatus via the router;

a response interval adjustment unit operable to obtain a response interval included in the packet data at which response packet data is sent to the home terminal apparatus, and determine a response period during which the response packet data is sent; and

a second packet generation unit operable to generate the response packet data to be sent to the home terminal apparatus.

24. The communication system according to Claim 23,

wherein the communication unit in the home terminal apparatus sends the packet data periodically and repeatedly to the router according to the sending interval,

the holding unit in the router holds the corresponding relationship between the global address and the local address of the home terminal apparatus, and

the second communication unit in the server apparatus sends the response packet data according to the response period.

25. The communication system according to Claim 23,

wherein the home terminal apparatus further includes a detection unit operable to detect the predetermined period of time during which the corresponding relationship is held in the router,

wherein the judgment unit judges that the period detected by the detection unit or a period shorter than said period is the sending interval.

26. The communication system according to Claim 23,

wherein a mobile terminal device for sending a control request to control the specific home terminal apparatus is further connected to the external network, and

the second packet generation unit in the server apparatus

receives the control request sent by the mobile terminal device, and generates control packet data including said control request, and

the second communication unit sends the control packet data to the home terminal apparatus via the router.

27. A communication method used for a communication system in which an external network to which a server apparatus is connected and a home network to which a home terminal apparatus is connected are connected via the router, the communication method comprising steps A executed by the home terminal apparatus, steps B executed by the router, and steps C executed by the server apparatus,

wherein the steps A include:

a packet generation step of generating packet data to be sent to the server apparatus;

a judgment step of judging a sending interval at which said packet data is sent; and

a communication step of sending/receiving the packet data to and from the server apparatus via the router,

the steps B include:

an assignment step of assigning a unique local address to the home terminal apparatus;

a holding step of holding a corresponding relationship between a global address assigned to the router and the local address of the home terminal apparatus for a predetermined period of time; and

a conversion step of making a conversion between the local address and the global address included in the packet data sent by the home terminal apparatus or the server apparatus, with reference to the corresponding relationship, and

the steps C include:

a second communication step of receiving the packet data

sent by the home terminal apparatus via the router;

a response interval adjustment step of obtaining a response interval included in the packet data at which response packet data is sent to the home terminal apparatus, and determining a response period during which the response packet data is sent; and

a second packet generation step of generating the response packet data to be sent to the home terminal apparatus.

28. A program for a communication method in which an external network to which a server apparatus is connected and a home network to which a home terminal apparatus is connected are connected via the router, the program comprising steps A executed by the home terminal apparatus, steps B executed by the router, and steps C executed by the server apparatus,

wherein the steps A include:

a packet generation step of generating packet data to be sent to the server apparatus;

a judgment step of judging a sending interval at which said packet data is sent; and

a communication step of sending/receiving the packet data to and from the server apparatus via the router,

the steps B include:

an assignment step of assigning a unique local address to the home terminal apparatus;

a holding step of holding a corresponding relationship between a global address assigned to the router and the local address of the home terminal apparatus for a predetermined period of time; and

a conversion step of making a conversion between the local address and the global address included in the packet data sent by the home terminal apparatus or the server apparatus, with reference to the corresponding relationship, and

the steps C include:

a second communication step of receiving the packet data sent by the home terminal apparatus via the router;

a response interval adjustment step of obtaining a response interval included in the packet data at which response packet data is sent to the home terminal apparatus, and determining a response period during which the response packet data is sent; and

a second packet generation step of generating the response packet data to be sent to the home terminal apparatus.

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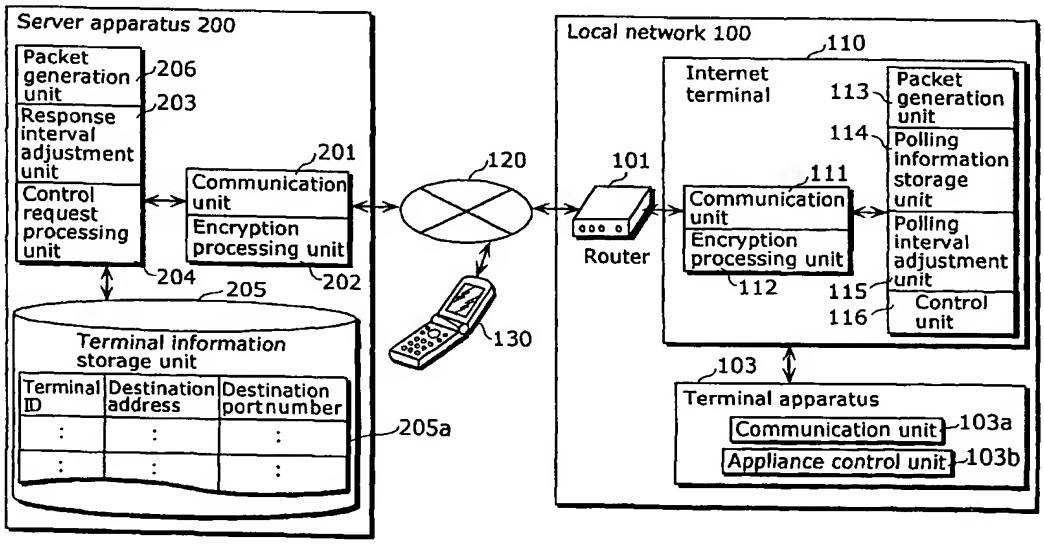
[Continued on next page]

(54) Title: HOME TERMINAL APPARATUS AND COMMUNICATION SYSTEM



(57) Abstract: An internet terminal (110) according to the present invention is comprised of: a communication unit (111) that sends a local packet generated by a packet generation unit (113) and receives a response local packet from a server apparatus (200); an encryption processing unit (112) that encrypts the local packet to be sent out and decrypts the received response local packet; the packet generation unit (113) that generates the local packet; a polling information storage unit (114) that holds a terminal ID and a password used for identifying the internet terminal (110); a polling interval adjustment unit (115) that identifies a polling interval at which the local packet is periodically sent to the router (101); and a control unit (116) that sends control information to a terminal apparatus to be controlled and controls such terminal apparatus accordingly.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 03/11182

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/25880 A (BLOUIN FRANCOIS F ;NORTEL NETWORKS LTD (CA)) 28 March 2002 (2002-03-28)	1
A	page 2, line 3 - line 8	2-21, 23-28
Y	page 6, line 2 - line 25 page 10, line 31 - line 32 figures 1,5,10	22
X	US 6 161 123 A (HECKT STEVE ET AL) 12 December 2000 (2000-12-12)	1
A	column 10, line 4 - line 28 column 12, line 53 - line 62 column 13, line 8 - line 52 figure 8	2-21, 23-28

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 April 2004	

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Jaskolski, J

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 03/11182

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97/40610 A (NORTHERN TELECOM LTD) 30 October 1997 (1997-10-30) page 5, line 18 - line 34 page 13, line 5 - line 16	1-28
A	US 6 128 664 A (YANAGIDATE KAZUHIKO ET AL) 3 October 2000 (2000-10-03) column 7, line 3 - line 52 figures 2,7	1-28
Y	US 2002/094081 A1 (MEDVINSKY ALEXANDER) 18 July 2002 (2002-07-18) paragraph '0004! paragraph '0016! - paragraph '0019! paragraph '0029! - paragraph '0040! claim 1	22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP 03/11182

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/ JP 03 /11182

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,2

home terminal apparatus comprising a detection unit operable to detect a period of time during which the relationship between a global and a local address is held in a router;

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2. claims: 1,3-21,23-28

a home terminal apparatus generating a packet including in a data part a response interval at which response packet data is sent as a response from a server apparatus, a communication system, method and a program, having a response interval adjustment unit/step to obtain the response interval included in the packet data;

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3. claims: 1,22

home terminal apparatus comprising an encryption processing unit;

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/JP03/11182

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